GENETIC VARIABILITY AND GENOTYPIC, PHENOTYPIC CORRELATION STUDIES FOR YIELD AND RELATED TRAITS IN SINGLE CROSS HYBRIDS OF MAIZE (*Zea mays L.*)

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Abstract

The study was connected to evaluate seven mays hybrids for genetic variability for yield components at Faculty of Agriculture and forestry field university of Duhok during spring 2011 and 2012 .

The result show highly significant different between the genotype for plant height, leaf area , and significant at 0.05 level for ear height ,number. of grain ear^{-1} and non-significant for 300-grain weight and grain yield plant^{-1} in spring 2011. While the main square for genotype was highly significant for leaf area and significant for plant height, ear height ,number of row ear-^{1},and non-significant for rest characters ,also show significant effect between hybrid and yield. Plant height exhibited significant positive genotypic correlation with ear height, leaf area ,300-grain weight ,and not significant with yield plant^{-1} while the phenotypic correlation show appositive non significant correlation between number of row with leaf area with (rph =0.60).

KEYWORDS*: Hybrids ,Yield ,Phenotypic ,Genotypic , Variability*

Introduction

The use of hybrids was most important advance in the cultivation of maize. The first commercial sale of hybrid seed started in 1984.Inbred lines of Maize show general deterioration in yield and vigor, but hybridization between two inbred immediately and completely recovers. In many cases their yield exceeds that of the varieties from which inbred were derived (shull,1908).Increased production per unit area is the primary objective in maize breeding programs and grain yield is the most important and complex character with the maize breeders work which inherited trait being quantitatively controlled by numerous minor genes , as a result of different vital processes of plants, such as photosynthesis ,transpiration and storage of food materials , maize display an orderly sequence of development o n yield components number of ear plant^{-1},number of kernels row ,number of rows in ear and kernel weight (Viola *et al.*, 2003).Genetic improvement in traits of economic importance along with maintaining sufficient amount of variability is always the desirable objective in maize breeding programs (Hallauer and Scobs,1973).

The variability is a key to crop improvement (Welsh,1981).Grzesiak (2001) observed considerable genotypes variability among various maize genotypes for different traits. .Ihsan *etal*., (2005) also reported significant genetic differences for morphological parameter for maize genotypes .

Large amount of genetic variability has been observed to occur in the original accessions and races among sampled population representing different climatic and geographical regions (Ilarsalan *et al*.,2002),(Abayi *et al*.,*(2004)*, (Naushad *et al*.,2007), and Melil *et al*.,(2013) Observed significant genetic variation in important agronomic traits. Selection for specific trait is known to result in correlated response in certain other traits.

Improvement yield is the most important target trait in most of crops.AL-Ahmad, (2004), Aydin *et al*.,(2007) and Najeeb *et al*.,(2009) indicated that the correlation value were positive and significant between grain yield and each of ear diameter ,ear length and number of kernels row^{-1}. Brar *et a*l.,(2008) denoted that studies conducted on (15) single cross hybrid (F1) maize over two locations revealed ear length and number of rows^{-1} ear had significant positive correlation with yield .

The present study was conducted to evaluate the performance of different maize hybrids and genotypic and phenotypic correlation between tries under agroclimatic condition of Duhok ,Kurdistan Region -Iraq.

Materials and methods

The present study was conducted to evaluate seven maize hybrids for genetic variability(IK8 ×IK58 ,ZP707× UN44052 ,IK8 × HS ,IK8 × DK ,OH40 × ZP-301 ,IK8 × OH40, UN44052× DK) in yield and yield components at Faculty of

Agriculture and Forestry field university of Duhok, during spring 15/3/2011 and 2012.

These hybrids were selected from maize programs which were applied in the field crops department of Faculty of Agriculture and were having more heterogeneity as compared to the synthetic.

The experiment was laid out in randomized complete block design with three replications.

The genotypes were grown in two rows plots, with row length of 3m having row to row and plant to plant distance of 0.75 and 0.25 m respectively .Two seeds per hole were planted, which were thinned to one plant per hole at 4-5 leaf stage. Compound fertilizer ,NPK Russian origin, 17,17,17 was added with quantity 600kg/ha after plowing and urea 46% N once with quantity 200kg /ha at the beginning of flowering .Standard cultural practices were followed from sowing till harvesting during the entire crop season .

The data recorded on the basis of the average experimental unit (five plant per experimental unit) ,for yield related traits viz, number of grain row^{-1} number of row per ear^{-1} , 300-grain weight and grain yield plant^{-1}.Data were statistically analysis using analysis of variance appropriate for randomize complete block design. Mean were compared using Multiple Range Test at 0.01 and 0.05 level of probability (steel and Torric 1984).

Result and discussion

The analysis of variance (Table 1) showed the mean square of genotypes was highly significant for plant height, leaf area and significant at 0.05 level for ear height, Nu. of rows/ear $^{-1}$,Nu .of grain ear^{-1} and non-significant for 300 grain weight and grain yield plant^{-1} in spring 2011,while the mean square for genotype was high significant for leaf area and significant for plant height, ear height, Nu. of row ear^{-1} and non-significant for the other characters in spring 2012 .

Table (1): The analysis of variance for yield and some studied characters.

s.o.v	d.f	year	M.S						
			Plant height (cm)	Ear height (cm)	Leaf area (Cm^2)	Nu.of rows ear^{-1}	Nu.of grains row^{-1}	300grain weight (g)	grain yield plant^{-1} (g)
Replicates	2	2011	2.88	2.64	4568.47	6.04	4.33	214.31	824.03
Hybrids	6		308.72**	137.72 *	33681.15 **	6.63*	23.93	53.71	795.33
Error	12		3.03	1.20	733.81	2.82	5.38	100.73	344.55
Replicates	2	2012	60.33	9.47	2651.80	3.04	10.90	81.11	1114.28
Hybrids	6		193.99 *	163.02*	19795.91**	3.74	22.52	14.64	207.79
Error	12		77.51	42.22	876.27	1.93	20.23	16.68	260.37

Table (2) showed combing analysis results of genotypes across for seven characters of maize. The mean square of genotypes was height significant for plant height, leaf area and significant for the other characters .The mean square of year was significant at 0.01 level for all studied characters except grain yield plant^{-1} which was significant at 0.05 level while Number of rows ear^{-1}was not significant. The Years x Hybrids interaction was significant for all the studied characters except Nu.of rows ear^{1}.

Table (2): combing analysis for two years and some characters for maize varieties .

S.O.V	d.f	Plant height (cm)	Ear height (cm)	Leaf area (cm^2)	Nu.of $row ear^{-1}$	Nu.of grains row^{-1}	300grain weight (g)	grain yield $plant^{-1}$ (g)
Years	1	2608.03**	1167.88 **	150335.56**	0.20	168.02 **	514.80 **	291.97 *
Repl.X years	4	65.37	29.25	8882.68 **	4.79 *	14.45 *	83.08 *	525.10 *
Hybrids	5	286.71 **	95.42 *	25967.08 **	4.89 *	22.13 *	18.24	398.11 *
Years X Hybrids	5	98.23 *	100.53 *	2866.45 *	2.24	17.86 *	65.50 *	961.23 *
Error	5	36.79	17.75	1177.50	1.34	3.76	22.04	71.24

Table (3) confirmed that the effect of years on grain yield and its components were significant in all characters with the exception of nu. of rows ear^{-1} .Results indicated the exceeding of the year 2012 in all studied characters compared to year 2011 by 165.9 ,78.35 , 669.90 , 39.30 ,51.50 ,86.95 for the characters plant height ,ear height , Leaf area ,Nu.of grain row^{-1} ,300 grain weight and grain yield $plant^{-1}$,respectively.

Table(3): effect of years in grain yield ,its components and grown characters.

character years	Plant height (cm)	Ear height (cm)	Leaf area (cm^2)	Nu.of $row ear^{-1}$	Nu.of $grains row^{-1}$	300grain weight (g)	grain yield $plant^{-1}$ (g)
2011	143.63 b	63.41 b	500.49 a	16.00 a	33.63 b	61.65 a	79.48 a
2012	165.95 a	78.35 a	669.90 a	15.80 a	39. 30 a	51.50 a	86.95 a

Data in table (4) indicated that there is significant difference between hybrids in all studied characters.

The results of the effect of genotypes on plant height revealed significant differences between genotypes, and the maximum plant height record by the hybrid (IK8 x HS) (170.13 cm) ,while the minimum plant height recorded by hybrid (IK8 x IK58) (142.33 cm). For ear height the genotypes (IK8 x DK) surpassed others genotypes (75.50 cm), followed by the (ZP707 x UN44052) which gave (74,36 cm) but the genotype (IK8 x IK58) was inferior (62.00 cm).

The data in the same table indicated the maximum Leaf area value recorded by the hybrid (OH40 x ZP-301) market with 733.99cm^2 and followed by the hybrid (IK8 x DK)with 646.53 cm^2, while the minimum value exhibited by the hybrid (IK8 x HS) which was 573.73 cm^2.

From the same table, the hybrid (IK8 x OH40) showed the highest number of rows ear^{-1} which reached 18.00 rows. Minimum value recorded by hybrid (IK8 x IK58) (13.33 rows) The predominating of hybrid (IK8 x OH40) compared to hybrid (IK8 x IK58) was recorded 25 % .

Concerning effect of hybrid on Nu. of grains row^{-1} ,was also influenced significantly, (table 4) showed that the hybrid (ZP707 xUN44052) gave the highest Nu. of grains row^{-1} (40.33) , but the least value was (33.00) in hybrid (IK8 xHS).For the 300 grain weight ,no significant difference were noticed between all hybrids and the value rang between 55.00 to 59.79 for hybrid (IK8 x IK58) and hybrid (ZP707 x UN44052) respectively.

The data in table (4) showed that there is no significant differences observed between the hybrids in plant yield except the hybrid (IK8 x IK58)which record 60.96g where compared with the hybrid (IK8 x SH) (91.72) . This finding are accordance with; Najeeb *etal*.(2009).Brar *et al*.(2008). and Aydin *et al*.(2007)

Table (4): Effect of genotypes on studied characters.

variety	Plant height (cm)	Ear height (cm)	Leaf area (cm^2)	Nu.of rows ear^{-1}	Nu.of grains row^{-1}	300grain weight (g)	grain yield $plant^{-1}$ (g)
IK8 x IK58	142.33 c	62.00 c	536.41 cd	13.33 c	39.00 ab	55.00 a	60..96 b
Zp707xUN44052	158.16 ab	74.36 ab	571.76 c	16.33 ab	40.33 a	59.79 a	85.80 a
IK8 x HS	170.13 a	75.33 a	573.76 c	15.33 bc	33.00 d	59.70 a	91.72 a
IK8 x DK	158.66 ab	75.50 a	646.53 b	16.00 ab	34.66 cd	53.60 a	79.56 a
OH40 x ZP-301	150.43 bc	69.10 abc	733.99 a	16.66 ab	35.33 bcd	58.42 a	90.56 a
IK8 x OH40	148.73 bc	68.33 bc	527,79 cd	18.00 a	38.00 abc	55.40 a	84.96 a
UN44052 x DK	151.36 bc	72.66 ab	477.93 d	15.66 abc	34.00 cd	55.16 a	87.66 a

Table (5) showed significant effect of interaction between hybrids and years .The maximum plant height value recorded by the interaction of hybrid(IK8 x HS) with the year2 was 182.50 cm, and followed by 171.00cm exhibited by the interaction between hybrid (UN44052 x DK) with the same year, while the lowest plant height value recorded by the association between hybrid (IK8 x IK58) with year1 was 128.50 cm . Regarding effect the interaction between hybrids and years ,maximum ear height exhibited by hybrid (IK8 x HS)with the year 2 was 90.50cm and the minimum value was52.50 cm ,by the interaction hybrid (IK8 x IK58) with the year1.Fore the Leaf area the maximum value which was 819.00 cm^2 by the interaction (OH40xZP-301)xY2 which the lowest value exhibited by the interaction(ZP707xUN44052) xY1 with 385.91 cm^2.The same table showed significant differences effect of interaction between genotypes and years in Nu. of rows ear^{-1} ,the interaction between (OH40xZP-301)xY1 and (IK8xOH40) xY1 recorded the maximum Nu.of rows ear^{-1} which were 18.00 rows and the lowest value was 13.00 rows by the interaction between (IK8xIK58)xY1 .From the Nu.of grains row^{-1} ,the interaction between(IK8xIK58)xY2 gave maximum Nu.,of grains row^{-1} while the lowest Nu.of grains row^{-1} was 30.00 exhibited by the interaction between (UN44052xDX) xY1 . Regarding the 300 grain weight ,the differences of the interaction effect on the 300 grain weight ,the highest value was 75.23 g. at the interaction between (ZP707xUN44052)xY1 ,while the lowest value recorded by the interaction (IK8xIK58)xY2 which was 44.64g.The results were confirms in (table 5),where the interaction was significant the treatment (IK8 xOH40) xY1 have highest grain yield $plant^{-1}$ with (113.46 g) followed by (IK8 x HS)xY1 with 104.10 g ,while the treatment (ZP707xUN44052)xY1 gave the lowest value with 51.72 g .This result agreement with Grzesiak(2001); Naushad *et al*.,(2007); Ihsan et al.(2005); and Al.Ahmad *et al*.(2004) .

Table(5): effect of interaction between genotypes and years on studied characters.

Years	variety	Plant height (cm)	Ear height (cm)	Leaf area (cm^2)	Nu.of rowsear^{-1}	Nu.of grains row^{-1}	300grain weight (g)	grain yield plant^{-1} (g)
2011 (Y1)	IK8 x IK58	128.50 f	52.50 f	444.62 fg	13.00 c	34.00 def	60.00 abcde	52.86 d
	ZP707 x UN44052	135.00 ef	55.60 ef	385.91 g	17.00 ab	36.00 cdef	75.23 a	51.72 d
	IK8 x HS	163.95 abc	67.75 cde	519.72 ef	16.00 abc	32.50 ef	69.24 ab	104.10 ab
	IK8 x DK	144.50 cdef	71.50 bcd	525.85 ef	16.00 abc	34.00 def	55.70 bcde	61.97 cd
	OH40 x ZP-301	144.40 cdef	67.65 cde	691.49 bc	18.00 a	33.00 ef	56.50 bcde	85.84 abc
	IK8 x OH40	143.70 def	65.00 def	418.21 fg	18.00 a	40.00 bcd	64.44 abc	113.46 a
	UN44052 x DK	141.55 ef	64.85 def	431.89 fg	15.50 abc	30.00 f	59.28 abcde	80.78 bc
2012 (Y2)	IK8 x IK58	170.00 ab	81.00abc	720.00 ab	14.00 bc	48.00 a	44.64 e	77.17 bcd
	ZP707 x UN44052	169.75 ab	83.75 ab	664.69 bcd	16.00 abc	42.00 ab	52.08 cde	102.84 ab
	IK8 x HS	182.50 a	90.50 a	681.75 bcd	14.00 bc	34.00 def	50.16 cde	66.99 cd
	IK8 x DK	165.75 ab	77.50 abcd	706.88 b	16.00 abc	35.00 def	52.56 cde	88.36 abc
	OH40 x ZP-301	162.50 bcd	72.00 bcd	819.00 a	14.00 bc	40.00 bcd	62.28 abcd	100.03 ab
	IK8 x OH40	151.25 bcde	65.50 def	582.58 bcd	18.00 a	37.00 bcde	50.89 cde	70.71 cd
	UN44052 x DK	171.00 ab	86.50 a	570.00 de	16.00 abc	42.00 abc	46.92 de	101.44 ab

Plant height exhibited significant positive genotypic correlation with ear height rG=0.67(Table 6).

However the genotypic correlation of plant height with Leaf area, 300 kernel weight and yield was not significant. Plant height showed significant positive phenotypic correlation with ear height (rph= o.65) and non significant with other traits .positive and significant genotypic between ear height with leaf area and kernel yield plant^{-1} with (rG= 0.55 and rG =60) respectively.

The same result obtained in case of phenotypic correlation between ear height and leaf area, rph = 0.53. The other traits showed positive or negative and non-significant genotypic between them

Table (6) Genotypic (Above Diagonal and phenotypic Bellow Diagonal) correlation among various traits of seven maize hybrid-2011.

	Plant height(cm)	Ear Height (cm)	Leaf area (cm^2)	Nu.of rows ear^{-1}	Nu.of grains row^{-1}	300grain weight (g)	grain yieldplant^{-1} (g)
Plant height(cm)		0.67**	0.33	0.32	0.05	0.33	0.50
Ear height (cm)	0.65*		0.55*	0.26	0.21	0.19	0.60*
Leaf area (cm^2)	0.29	0.53*		0.11	-0.07	0.18	0.35
Nu.of row ear^{-1}	0. 19	0.11	0.12		0.01	-0.07	0.13
Nu.of grains row-1	0.03	0.14	-0.12	-0.05		0.12	0.45
300grain weight(g)	0.15	0.09	0.06	-0.16	0.24		0.29
grain yield plant^{-1} (g)	0.35	0.39	0.13	-0.005	0.37	0.27	

rG = genotypic correlation
rph = phenotypic correlation

Table(7): Genotypic(above Diagonal and phenotypic bellow Diagonal) correlation among various traits of seven maize hybrid -2012.

	Plant height (cm)	Ear height (cm)	Leaf area (cm^2)	Nu.of $rowsear^{-1}$	Nu.of grains row^{-1}	300grain weight (g)	grain $yieldplant^{-1}$ (g)
Plant height(cm)		0.56*	0.10	-0.37	0.09	-0.13	0.20
Ear height (cm)	0.43		0.03	-0.39	0.04	-0.01	0.12
Leaf area (cm^2)	0.03	-0.05		-0.73 **	-0.17	0.39	0.23
Nu.of row ear^{-1}	-0.22	-0.24	-0.60 *		-0.10	-0.30	-0.002
Nu.ofgrains row^{-1}	-0.06	0.00	0.01	-0.41		-0.37	0.33
300grain weight(g)	0.08	0.01	0.27	-0.20	-0.94		0.08
grain yield $plant^{-1}$ (g)	0.09	0.14	0.20	-0.13	0.11	0.40	

The data in table (7) showed the genotypic and phenotypic correlation between the many traits .The plant height exhibited a positive genotypic correlation with ear height and positive or negative genotypic correlation and significant with the other traits .Leaf area showed negative genotypic correlation with no .of row ear^{-1} with (rG=0.73) while the phonotypic correlation showed a positive and significant correlation between Nu. of row ear^{-1} with Leaf area with (rph=0.60) ,but the remaining traits showed positive and negative phenotypic correlation between them.

Conclusion

preceding results and discussion revealed that different maize hybrids have performed differently for yield and yield component may be concluded that maize and have resulted in better performance for yield and yield components, and are recommended for commercial cultivation in Duhok and other location having the similar climatic condition, after development of improved production technology, and also it concluded that selection for genotypes having high yield potential may be based on plant height and Nu. of row ear^{-1}.

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الخلاصة:

اجريت هذه الدراسه لتقويم التباين الوراثي للحاصل ومكوناته لسبعة هجن من الذره الصفراء للموسمي الربيعي ٢٠١١ و٢٠١٢ في حقل كلية الزراعه والغابات جامعة دهوك .

أظهرت النتائج وجود فروقات عاليه المعنوية بين التراكيب الوراثيه لأرتفاع النبات والمساحه الورقيه في حين كانت الفروقات على مستوى ٠،٠٥لأرتفاع النبات وعدد البذور للعرنوص غير معنويه لصفة وزن ٣٠٠ حبه وحاصل النبات للموسم الربيعي ٢٠١١.بنما كانت الفروقات عالية المعنويه للمساحه الورقيه ومعنويه لأرتفاع العرنوص وغير معنوي لبقية الصفات ،كما أظهرت النتائج وجود علاقة إرتباط بين إرتفاع بين النبات وإرتفاع العرنوص والمساحه الورقيه ووزن ٣٠٠ حبه وغير معنويه مع حاصل النبات ،كما أظهرت إرتباط المظهري إرتباط موجب وغير معنوي مع عدد الصفوف للعرنوص الواحد والمساحه الورقيه ، بينما كان ألأرتباط موجبآ وغير معنويه بين عدد الصفوف للعرنوص و المساحه الورقيه بقيمة ٦٠،٠ .